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Date Culture in the United States

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DATES are grown commercially in the desert sections of southern California and Arizona. Fruit production increased from 1 million pounds in 1926 to more than 18 million pounds[1] in 1944. During the 10 years prior to the Second World War, importations of dates from the Old World averaged approximately 50 million pounds annually.

Irrigation projects completed or nearing completion along the lower Colorado River will result in a great expansion of agriculture in this area in the very near future. The date palm is so different from the fruit trees with which new settlers are likely to be familiar that information concerning its peculiar cultural requirements must be available before it can be grown and fruited successfully.

[1] This figure does not include 2 million pounds of cull dates, mostly dropped and unpollinated fruit, salvaged for byproducts during the war. Also, it does not include the Arizona production, for which no data are available but which may have been as much as a million pounds in 1944.

Although the date palm has been grown since the dawn of history in the deserts of the Old World, the establishment of a commercial date industry here dates from the beginning of the present century and has been to a large extent the result of experimental work by the United States Department of Agriculture and of the experience of pioneer date growers. This circular, a brief summary of date culture in the light of research and experience in the Southwest, will be of interest primarily to the relatively inexperienced commercial date grower. Owners of seedling date palms scattered here and there from southern California to Florida may find in it information of value, because in many instances such palms can produce good fruit for home use when the technique of pollination and fruit handling is known.

DATE-GROWING DISTRICTS IN THE UNITED STATES

In 1943 there were 3,275 acres of dates in California (*14*),[2] distributed as follows: 3,034 in Riverside County (Coachella Valley; fig. 1), 187 in Imperial County (Imperial Valley and Yuma Valley, California side), 30 in San Diego County (Borego Valley), 16 in Inyo County (Death Valley), and 8 in San Bernardino County.

In addition, there were approximately 500 acres of dates in Arizona.[3] Of these about 350 acres were in the Salt River Valley near Phoenix, about 100 acres in the Colorado River Valley near Yuma, and the remainder scattered mostly in the Gila Valley and the upper Colorado River Valley.

These statistics do not give an accurate idea of the relative importance of date culture in the districts named. In California approximately 3,000 acres were in commercial production, whereas in Arizona only about half of the total acreage was in production and a rather large percentage represented seedling palms or neglected plantings whose total output was small and relatively unimportant.

There are a good many seedling date palms in Texas, principally in the lower Rio Grande Valley and in certain localities between Laredo and San Antonio. With the exception of a few specimens at Laredo and one or two other points, the only imported varieties of date palms in Texas are in two small experimental plantings recently begun by the State Agricultural Experiment Station, one at Weslaco, in the lower Rio Grande Valley, and the other at Winter Haven, near Carrizo Springs in the Winter Garden district. Preliminary trials at Winter Haven indicate that a few of the more rain-tolerant imported varieties may have limited possibilities in this district (*59*).

Seedling date palms are also to be found here and there in the other Gulf States across to Florida, but climatic conditions seldom permit fruit to ripen.

[2] Italic numbers in parentheses refer to Literature Cited, p. 42. Information relative to date culture in the principal date-growing countries of the Old World may be obtained from various publications in this list (*13, 15, 16, 18, 20, 33, 47*). In addition, many helpful articles on nearly all phases of the subject can be found in the reports of the Date Growers' Institute, Indio, Calif.

[3] Estimate from a survey made in 1938 by the writer, in cooperation with the Department of Horticulture of the University of Arizona.

FIGURE 1.—A commercial date garden in Coachella Valley, Calif., consisting of Deglet Noor palms about 15 years old. Note the paper covers over bunches to protect the fruit from rain.

ORIGIN AND DEVELOPMENT OF DATE CULTURE

The date is one of the oldest of the cultivated tree crops. The earliest known records in Mesopotamia (modern Iraq) show that its culture was already well established as early as 3500 B. C. Dates were probably being grown almost as early in the Nile Valley of Egypt. From western Iran (Persia) across Arabia and North Africa, dates have long been the principal source of food for the native populations.

The date palm was introduced into the Western Hemisphere by the early Spanish missionaries, who planted date seeds around many of their missions. A few of these original palms or their offshoot survivors, dating from plantings in the latter part of the eighteenth century or the early part of the nineteenth, are still to be found in southern California and below the border in Mexico (*29*). However, the damp climate of the coast, where most of the early missions were located, is not favorable to fruit production. It was not until seedlings planted in the hot interior valleys of California and southern Arizona in the middle of the nineteenth century began to come into bearing that attention was attracted to the commercial possibilities of date culture.

In 1890 the United States Department of Agriculture arranged through correspondence for a small importation of date offshoots from the Old World, but these later proved to be inferior sorts (*55*). It was not until 1900 and the years immediately following that offshoots of the better varieties were obtained by plant explorers of the Department who visited the date-growing regions of Algeria, Tunisia, Egypt, and Iraq (*17, 27, 28, 32, 53, 54*). In cooperation with the State agricultural experiment stations, experimental plantings were made, first in Salt River Valley, Ariz., and later in Coachella Valley, Calif. These experiments attracted the attention of prospective date growers and

FIGURE 2.—Flower clusters of the date palm as they appear when the spathe first opens: *A*, Female; *B*, male. (× about ⅕.)

led to several large commercial importations (1911–15) of offshoots from Algeria and Iraq, which made acreage plantings possible.

BOTANICAL RELATIONSHIPS OF THE DATE PALM

The date palm, one of the most important members of the family Palmaceae, is known botanically as *Phoenix dactylifera* L. The genus *Phoenix* is distinguished from other genera of pinnate-leaved palms by the upward and lengthwise folding of the pinnae

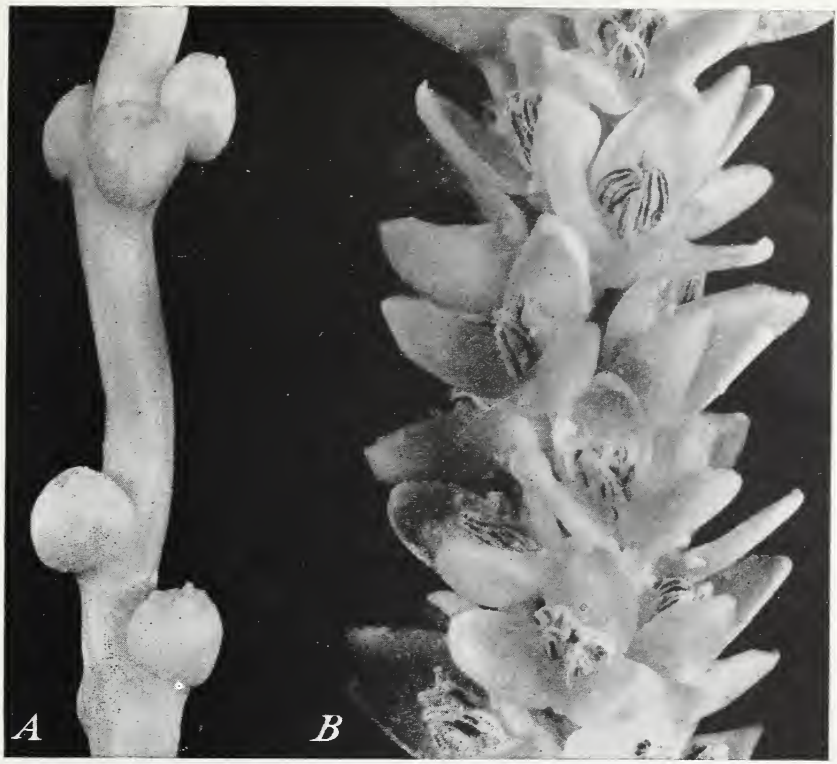


FIGURE 3.—Date flowers on strands removed from large flower clusters: *A*, Female; *B*, male. (× about 4.)

and the peculiarly furrowed seeds. There are about 12 species, all native to tropical or subtropical parts of Africa or southern Asia. Several of these are fairly well known as ornamentals, the most highly valued being *P. canariensis* Chabaud, the Canary Island palm, extensively used along driveways and in parks across the extreme southern portion of the United States. Another species, *P. sylvestris* (L.) Roxb., is cultivated in India as a source of sugar. *P. dactylifera* is distinguished from the 2 species just mentioned by the production of offshoots, or suckers, and from other species by its tall, columnar, relatively thick trunk (*8*). Close relationship among the species is indicated by the ease of cross-pollination and hybridization (*7*). All species are dioecious, male (staminate) and female (pistillate) flowers being produced in clusters on separate palms, in the axils of leaves of the previous year's growth (figs. 2 and 3). The inflorescence, or flower cluster, is a branched spadix and is enclosed prior to maturity in a protecting sheath, or spathe. Like other monocotyledons, the trunk lacks the cambium growth layer typical of fruit trees of the Temperate Zone and has only a single bud, or growing point. Leaves of the date palm are 10 to 20 feet long and have a normal life of 3 to 7 years. Old or dead leaves are not shed, but they are, of course, removed under cultivation.

TABLE 1.—*Average daily maximum air temperatures at 5 subtropical stations in the United States, as compared with those of 2 important date-growing regions in the Old World*

Station	Length of record	January	February	March	April	May	June	July	August	September	October	November	December	Annual average maximum temperature
	Years	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Miami, Fla.	19	74.3	74.8	76.8	79.7	82.5	85.4	86.9	87.3	86.0	82.8	77.6	75.2	80.8
Carrizo Springs, Tex.	8	66.5	73.5	78.7	85.9	91.3	96.1	99.1	99.2	93.4	85.0	74.0	65.5	84.0
Phoenix, Ariz.	35	65.0	69.1	74.1	81.8	90.0	100.9	102.7	100.9	96.7	85.9	74.5	65.0	83.9
Yuma, Ariz.	53	66.7	72.0	78.1	85.4	92.5	101.9	105.5	104.1	99.6	88.0	76.2	67.2	86.4
Indio, Calif.	25	69.6	74.8	79.6	86.2	92.7	102.1	106.5	105.5	100.6	90.7	80.4	70.7	88.3
Basra (Basrah), Iraq	19	60.0	65.2	73.7	84.0	94.3	100.6	104.4	104.9	101.3	90.6	77.0	64.0	84.9
Tozeur, Tunisia	9	59.4	65.5	72.5	81.3	89.1	99.7	107.1	104.6	93.7	83.2	70.5	60.3	82.2

TABLE 2.—*Rainy days and annual rainfall at 5 subtropical stations in the United States*

Station	Length of record	Average number of days with 0.01 inch or more of precipitation													Rainfall	
		January	February	March	April	May	June	July	August	September	October	November	Decembe:	Annual	Length of record	Average annual
	Years														*Years*	*Inches*
Miami, Fla.	19	9	6	7	7	12	13	15	15	18	16	10	7	135	46	59.78
Carrizo Springs, Tex.	8	2	3	3	3	5	3	3	2	4	3	3	2	36	9	19.80
Phoenix, Ariz.	35	4	4	4	2	1	1	5	6	3	2	3	4	39	55	7.43
Yuma, Ariz.	60	2	2	2	1	+	+	1	2	1	1	1	2	15	61	3.33
Indio, Calif.	33	2	2	2	1	0	0	0	1	1	1	1	2	13	52	3.00

CLIMATIC REQUIREMENTS

For proper maturing of fruit, the date requires prolonged summer heat and low relative humidity during the ripening period. The average daily maximum air temperatures of several localities in the United States (*56*) where dates are grown are compared in table 1 with those of two commercial date-producing districts of the Old World: Basra, Iraq *(26)*, and Tozeur, Tunisia (*28*). Miami, Fla., is included because it is typical of districts favorable to palm growth but not to date production.

At Indio, in the Coachella Valley, Calif., the maximum temperature frequently exceeds 110° F. and has been as high as 122°. Date leaves are injured by prolonged temperatures of 20° or below (*40*), but such low temperatures are of rare occurrence in the districts where dates are produced commercially in the United States.

Since rain occurring any time from early summer through the harvest season is likely to cause more or less damage to the fruit, commercial date culture has been developed only in districts where there is an almost complete absence of rain during that part of the year. It will be seen from table 2 (*56*) that in all districts in the United States where date palms will grow rain sometimes occurs during this critical period, but the danger of rain damage to the fruit is greater in some localities than in others. However, the amount of any particular rain is of less importance than the conditions under which it occurs. A light shower accompanied by prolonged periods of cloudy weather and high humidity may cause more damage than a heavy rain followed by clear weather and drying winds.

SOIL REQUIREMENTS

Dates are grown on a wide variety of soils. The maximum water-holding capacity consistent with good drainage is desirable. Coarse sand requires excessive fertilization and irrigation and permits rapid leaching of mineral nutrients unless underlain by more retentive soil of finer texture somewhere in the first 6 feet. On the other hand, good growth and production cannot be expected unless the soil takes water readily to a depth of 6 or 8 feet. Some of the finest date gardens in southern California are on deep sandy loams.

Although the date palm will grow in soils containing more alkali or salts than many other plants will tolerate, observations in the Southwest indicate that best palm growth and fruit quality cannot be obtained under relatively saline soil conditions. In view of the large investment required to bring a date garden into bearing and maintain it in profitable production, the best soil obtainable will be the cheapest in the long run.

PROPAGATION BY SEEDS

Dates may be grown either from seeds or from offshoots. When grown from seeds, approximately half of the palms will be male and produce only pollen. No two seedling palms are alike, and relatively few of them are likely to produce fruit of good quality. However, when a seedling palm appears outstanding in

any way it can be propagated by its offshoots, which will always reproduce the parent type; then it becomes essentially a new variety or clone. Some new varieties originating in the date-producing districts of California and Arizona have been named, are being propagated, and may have promise for the future; however, it takes many years to prove their commercial value and to propagate sufficient offshoots for large plantings. In those parts of southern California and Arizona where it has already been demonstrated that the better imported varieties of dates can be grown, it is not desirable to plant seeds except for experimental purposes.

Where conditions are known to be unfavorable to fruit production, as in Florida and elsewhere around the Gulf of Mexico, the planting of date seeds of varieties more tolerant to rain is the most economical way of getting a few palms that may occasionally provide fruit for home use. Because the young plants are small and rather inconspicuous for the first 2 or 3 years, the mistake is often made of planting date seeds so close that bearing is delayed and subsequent handling made difficult.

It is suggested that seeds be planted in the spring, 1 to 2 inches deep and 6 feet apart in rows 30 feet apart. If approximately four out of five of the palms are culled out later, the planting will be of about the right density and there will be no necessity for transplanting. The palms finally remaining will stand somewhat irregularly in rows, but interplanting can be carried on between the rows while they are young and regular cultivation can always be maintained in one direction.

PROPAGATION BY OFFSHOOTS

Rooting Offshoots

A date variety, whether male or female, can be propagated only by offshoots, which develop from axillary buds on the trunk chiefly during the early life of the palm. When, after 3 to 5 years of attachment to the parent palm, these offshoots have produced roots and have started to produce a second generation of offshoots, they are then ready to be removed. To promote rooting, the base of the offshoot should be in contact with moist soil for at least a year prior to cutting. For offshoots slightly above the soil surface, this can be accomplished by mounding up the soil. For high offshoots soil may be held around the base by means of boxes, but unless very valuable they are more often allowed to become quite mature on the palm and then are placed in a nursery for rooting.

The size of the offshoot when ready for cutting will vary with the variety, commonly ranging from 40 to 100 pounds in weight and from 8 to 14 inches in maximum diameter. Experience indicates that it is safer to leave an offshoot on the parent palm a little too long than to remove it before it is mature and well rooted, but there will be less injury to the palm and better development of offshoots if each one is cut as it matures.

Pruning Offshoots

In general, no green leaves should be removed from an offshoot until it is cut from the parent palm, as the growth of an offshoot will be in proportion to its leaf area. However, when a palm is

crowded with offshoots, the leaves on the smaller ones are sometimes cut back close to the bud to retard their growth until a few of the larger offshoots selected for removal first have been taken from the palm; subsequently the larger of the remaining offshoots may be selected for the next year's cutting and all their leaves retained until the offshoots are removed. When leaves interfere with cultivation, they may be tied up.

Removing Offshoots

The cutting of a date offshoot from the parent palm is an operation requiring care and skill, which can be acquired only by experience, and whenever possible the beginner is advised to learn the technique by watching and assisting a skilled operator. The soil is first dug away from the offshoots with a sharp, straight-blade shovel, leaving a ball of earth, 2 or 3 inches thick, attached to the roots but exposing the connection on each side. Dry or sandy soil does not adhere readily to the roots, but the roots should not be cut closer than suggested, for, although most of the cut roots die, there is danger of injuring new roots just emerging. Irrigation several days prior to cutting makes it easier to dig and ball the offshoots.

The offshoot is cut from the parent palm by means of a specially designed chisel. This consists of a rectangular cutting blade made of the best tool steel, highly tempered, which is welded to a tough iron handle. One side of the blade is flat, and the other side is beveled so as to form three sharp cutting edges. A chisel of the following dimensions has been found convenient for general use: Blade, 4½ inches wide, 9 inches long, and 1 inch thick; handle, 48 inches long and 1¼ inches thick.

Two men are required for the cutting operation. A skilled workman handles the chisel, and under his direction a second man drives the chisel with an 8- or 10-pound sledge hammer (fig. 4).

Figure 4.—Cutting a date offshoot, showing chisel and sledge hammer in use.

If loose fiber and old leaf bases have been cut away, the operator can usually locate approximately the connection between the offshoot and the parent palm. The first cut is made to the side of the base of the offshoot close to the main trunk. The flat side of the chisel is put toward the offshoot and the beveled side toward the parent palm; this procedure will give a smooth cut on the offshoot and allow the beveled side to press away from the palm. In using these tools, special care must be taken to avoid injury to the workmen.

After the completion of a cut, the chisel is removed by working it up and down parallel to the cutting blade while exerting a steady outward pull. A single cut may sometimes sever the connection; more often one or more cuts from each side are necessary. No attempt to pry the offshoot from the palm should be made before the connection is severed. The diameter of the offshoot connection varies in different varieties and to a much lesser extent in different offshoots of the same variety.

The offshoots may be pruned before cutting, and if they are crowded on the palm it may be desirable to cut off the lower leaves and tie the remaining ones close together in order to facilitate handling. However, some pruning is always necessary after cutting and all of it may often be more conveniently done then. The old leaf stubs and lower leaves are cut off close to the fiber. Ten or twelve leaves around the bud are retained and tied close together with heavy twine or wire. Then all the foliage is cut off even above the tie, leaving the lower 2 to 4 feet, the exact length depending somewhat on the size of the offshoot. The pushing out of the center leaves is an easily observed indication of subsequent growth.

Care should be taken to prevent the drying out of the roots between cutting and planting. Offshoots left any length of time in the field can be protected by throwing a little moist soil over the roots. Balling with wet sphagnum moss and burlap is often practiced with offshoots that are to be shipped some distance. Rough handling should be avoided, as it is quite possible for the bud and tender heart leaves to be damaged by being dropped or subjected to undue strain.

Planting Offshoots

Most varieties of dates are spaced 30 by 30 feet when planted; this spacing has in general given more satisfactory results than others that have been tried. However, a variety like Khadrawy, which grows slowly and makes a relatively small palm, can be planted 4 to 6 feet closer without undue crowding. If it is proposed to interplant with citrus, a greater distance than 30 feet between palms, at least one way, is probably desirable. Wherever there is considerable danger of rain damage during the ripening season, ample space for free air movement and exposure to sunlight between palms is important.

In most soils the early growth of the offshoot will be better if the holes are prepared a few months in advance of planting. They should be about 3 feet in diameter and 3 feet in depth and should be filled with a mixture of topsoil and barnyard manure and subsequently irrigated several times to promote decomposi-

FIGURE 5.—A date offshoot after planting, wrapped with burlap to protect the leaves.

tion of the organic material. Well-rotted manure may be used for holes prepared and irrigated shortly before planting, but in that event the precaution should be taken of putting the manure deep enough to allow a layer of soil at least 6 or 8 inches thick to be placed between the manure and the base of the offshoot. If not prepared in advance, the hole should be dug only deep enough to accommodate the offshoot, as otherwise the soil may settle after planting and lower the offshoot too much. A basin 6 to 12 inches deep and 4 to 6 feet across should be prepared around the planting location and the offshoot set in the center to the depth of its greatest diameter, usually about 14 to 20 inches, but never so deep that the water in the basin will reach the loose fiber near the bud (fig. 5). In planting it is very important that the base of the offshoot be in contact with the soil at all times. To avoid the formation of air pockets it is well at first to tamp in only enough moist topsoil to half fill the hole and then follow immediately with a light irrigation during which the hole is filled in to the level of the basin and the soil carefully worked in around the base of the offshoot.

It is essential that the soil in the vicinity of the newly planted offshoot be kept moist at all times by light, frequent irrigations. Frequent inspection should be made during the first few weeks to make sure that the surface soil does not dry and shrink away from the offshoot. To avoid this a mulch of hay or straw is of considerable value. The frequency of irrigation will depend somewhat on the soil type; during the first summer, daily irrigations may be desirable on very sandy soils; every second or third day will not be too often on most soils; on very heavy soils, once a week may be sufficient. Special care should be taken during the first few years after planting to prevent the establish-

ment of grass sod, which has often been observed to retard the growth of newly planted offshoots.

For protection against sun and wind during the first summer and against cold the following winter, the newly planted offshoot should be wrapped with burlap or with a layer of leafy material such as cornstalks or date leaves.

Basins are used for irrigation during the first few years after planting; they are enlarged from year to year to approximately the spread of the palm leaves. As the palms begin to come into bearing and after most of the offshoots have been removed, either the basin or the furrow method of irrigation may be used, depending upon the soil and the slope of the land.

SOIL MANAGEMENT

Irrigation

The importance of careful attention to irrigation in order to maintain good palm growth and high yields of fruit of the best quality cannot be stressed too much (*2, 34, 46, 48*). The frequency of irrigation will depend on soil texture and weather conditions. Bearing gardens on the lighter soils are usually irrigated every 7 to 14 days during midsummer and every 20 to 30 days during winter. On the heavier soils irrigations are somewhat less frequent. In some localities where a permanent water table occurs at a depth of 6 to 8 feet, even as few as 4 to 6 irrigations a year appear to be adequate. In any case soils should be kept moist to a depth of 7 to 8 feet. *The grower should make sure by means of a soil auger, tube, or shovel that the water is actually getting to the depths desired in all parts of the planting.* Some of the difficulties often encountered in getting water down to the proper depth deserve special mention.

Downward movement of irrigation water may be retarded by one or more layers of silt or silty clay. Frequently this condition occurs in only one or two small areas within a garden. Even when water sufficient for a row of palms is applied, rapid downward movement in sandy areas without silt layers may drain the water away from the area of slow penetration before the lower soil becomes wet. Basin flooding in the area of slow penetration usually helps to overcome this difficulty.

In coarse, sandy soils uneven distribution of water may result from such a rapid downward movement near the water outlet that it does not leave sufficient to reach the palms at the lower end of the run. Reducing the distance of water flow to 300 feet or less by installation of additional pipe lines and head stands is frequently desirable. Applying a larger stream of water down fewer rows or fewer furrows is effective, but usually it requires more attention by the irrigator.

Where the land is not properly leveled before planting, the water may flow rapidly to the lower end of the row and not remain in contact with the upper and middle portions of the row long enough for adequate penetration. Where the slope is too steep to permit correction by a moderate regrading, a smaller stream of water in each furrow or each row usually provides better distribution. Cross borders also may be used to hold water longer on areas of slower penetration.

When cover crops are grown or there is considerable weed

growth, such as Bermuda grass, provision for more water per irrigation or more frequent irrigations will be necessary. If adequate soil moisture cannot be maintained under such conditions, cultivation to reduce or prevent further cover-crop or weed development is advisable.

If an inspection of the soil fails to show sufficient moisture at lower depths throughout much of the garden, it is good evidence that insufficient water is being applied. It often happens that the frequency and amount of irrigation are not increased soon enough in the spring, and the increased requirements of the palm during warm weather make it difficult to supply enough water to reach the lower depths. When moisture becomes deficient in the subsoil, it may be necessary to irrigate two or three times in rapid succession and to apply as much as 8 to 12 acre-inches of water in order to wet the soil to a depth of 7 to 8 feet. Once the soil has been wet to the desired depth, 4 to 6 acre-inches of water per irrigation may be sufficient, depending on the period between irrigations, soil texture, and the efficiency of distribution.

Experience in Coachella Valley indicates that not less than 9 to 12 acre-feet of water per year is necessary for palms in full production and that from 12 to 18 acre-inches per month is required during the summer. Sufficient water must be applied to make up for evaporation loss from the soil surface, to supply palm requirements, and to prevent an accumulation in the root zone of the salts contained in the irrigation water. Additional water must be provided to take care of interplantings or cover crops.

If there is reason to suspect a heavy accumulation of salts in the soil, sufficient water must be applied to leach the salts out of the principal root zone of the palm (usually the first 6 or 7 feet of soil) and move them down to a lower depth. This may be done best by a heavy double or triple irrigation sometime during the winter. The use of irrigation water containing a high proportion of sodium may in time produce a soil texture unfavorable to penetration (*30, 31*). Under such conditions it may be beneficial to apply between 1 and 2 tons of gypsum per acre or between 200 and 400 pounds of sulfur worked into the soil prior to heavy irrigation to promote leaching. Winter cover crops are particularly valuable in improving water penetration under circumstances of this kind.

The grower should determine from time to time the amount of water that is actually being applied at each irrigation. The following formulas may be used to compute the depth of water applied to a given acreage in a given length of time:

$$\frac{\text{Cubic feet per second} \times \text{hours}}{\text{acres}} = \text{acre-inches per acre, or average depth in inches.}$$

$$\frac{\text{Southern California miner's inches} \times \text{hours}}{50 \times \text{acres}} = \text{acre-inches per acre, or average depth in inches.}$$

$$\frac{\text{Arizona and California statute miner's inches} \times \text{hours}}{40 \times \text{acres}} = \text{acre-inches per acre, or average depth in inches.}$$

These formulas are based upon the fact that a flow of 1 cubic foot per second, or 450 gallons per minute, approximates 1 acre-inch per hour, or 50 southern California miner's inches, or 40 Arizona and California statute miner's inches. Most wells in southern California are rated in southern California miner's inches.

Fertilization, Cover Crops, and Cultivation

Fertilization has generally been found necessary to maintain the quantity and quality of production, but there are few experimental data bearing on the kind and quantity of fertilizer or on the time of its application. Since a palm may make better growth in a good soil with little or no fertilization than in a poor soil with heavy fertilization, any fertilization program must be adapted to the soil type in each garden. However, the inexperienced grower will make no mistake if he follows the practices of the best date growers and modifies his procedure, when a change seems desirable, by varying the treatment on a few palms and then comparing their appearance and fruit production with similar palms in the same garden.

Animal manures are widely used in the better date gardens of the Old World. In California and Arizona barnyard manure is applied at the rate of 5 to 15 tons per acre. Steer manure is preferred because of its relatively higher nitrogen content (about 2 percent) as compared with cow or horse manure (½ to 1 percent). Manure is usually applied in late fall or winter unless a winter cover crop is grown, in which case it is usually put on in the spring after the cover crop has been turned under. Less manure may be required when cover crops are grown. With a heavy cover crop some growers omit manure and apply nitrogen in an inorganic or commercial fertilizer, enough being used to supply 2 or 3 pounds of actual nitrogen per palm per year. On light soils it may be desirable to divide this amount into two or three applications during the growing season to avoid loss by leaching. Sometimes commercial nitrogen fertilizers are also used to supplement the lighter applications of manure.

On most soils in arid regions tree crops have failed to respond to applications of potash and phosphorus. However, fertilizers that improve cover-crop growth probably indirectly improve the growth of the date palm, and the cover crop will often benefit from the application of some form of phosphorus, such as triple superphosphate, at the rate of about 200 pounds per acre.

Winter cover crops of sourclover or sweetclover or other legumes are often grown. The Hubam variety of sweetclover, planted in the fall, has given particularly good results in date gardens in the Coachella Valley, Calif. The turning under of a cover crop not only adds organic matter that decomposes readily and releases nutrients but also it promotes better water penetration and slightly increases water-holding capacity. Summer cover crops, such as sesbania and cowpeas, have been occasionally tried but are not generally used because of the heavy demand for water during hot weather.

Cultivation is commonly restricted to turning under cover crops or weeds and to preparing the land for irrigation.

PRUNING

There is considerable evidence (*41*, *43*) that, other things being equal, the bearing capacity of a date palm is in proportion to the number of green leaves that it carries. An insufficient number of leaves in proportion to the amount of fruit results in low quality of fruit during the current season and fewer inflorescences

the following spring. Therefore, it is desirable to retain all good green leaves unless there is some definite reason for removing them (figs. 6 and 7). A few leaves will usually have to be removed in order to put bags or covers on the bunches. Since a sufficient number of leaves in proportion to the crop is particularly important during the fruit-growing period, the maximum benefit from all leaves will be obtained if most of the pruning is delayed until August just before bags are put on the bunches. However, leaves that are partly dead may be removed at any convenient time, and because of greater ease in cutting it is desirable to remove them before the bases become hard and dry.

Sometime during the winter spines are removed from all leaves of the previous year's growth to facilitate pollination and subsequent handling of bunches. A sharp pruning knife with a long, curved blade mounted on a handle a foot or more in length is most frequently used for this work (fig. 8).

POLLINATION

Method of Pollination

Date palms are dioecious; that is, the male flowers, which produce the pollen, and the female flowers, which produce the fruit, are borne on separate palms. For commercial fruit production the female flowers must be pollinated by hand. The most common method of pollination is to cut the strands of male flowers from a freshly opened male inflorescence and invert two or three of them between the strands of the female flower cluster during the first 2 or 3 days after it has opened (fig. 9). Twine is tied around the pollinated cluster 2 or 3 inches from the outer end to hold the male flowers in place and to prevent the strands of the female cluster from becoming entangled as the cluster pushes out between the leaves. To provide for the expansion of the cluster as the fruit develops, the twine is commonly tied in a slipknot having the free end long enough to permit later adjustment to the maximum size of the bunch.

When held for a few days before being used, male flowers begin to dry and shatter; in this case it has been found more economical to use dried pollen. This dried pollen is generally applied by dusting it on cotton and placing one or two pieces about the size of a walnut between the strands of the female cluster. A few growers, who are well supplied with male palms, sift the pollen and apply it with insect dusters.

With careful pollination, from 50 to 80 percent of the flowers will usually set fruit; such a set is sufficient for a full crop.

Handling and Storing of Pollen

Male flower clusters should be cut early in the morning, as soon as possible after the spathe breaks, to prevent wind or bees from causing loss of pollen. Bags placed over the spathes before they open are occasionally used to conserve pollen and avoid loss when the clusters cannot be cut daily. In the Old World it is a common practice to cut the male spathe before it opens; but this procedure cannot be given an unqualified recommendation at present, for with the miscellaneous seedling males that are being used in the Southwest it is not always easy to make sure of the

FIGURE 6.—A young Deglet Noor palm with all its good green leaves (104) attached.

maturity of the inflorescence. However, the grower who becomes familiar with his best male palms will in many cases be able with a little experience to judge the maturity of the unopened inflorescence. Usually when the middle or lower portion of the spathe is pressed between the thumb and forefinger, a crackling noise will be produced if the flowers within are mature. The spathe can then be cut and carried to the storage room, and the flowers can be removed to dry.

As freshly opened flowers contain a great deal of moisture, it is very important, if they are not to be used immediately, to dry them out promptly. Otherwise molds develop and destroy the

FIGURE 7.—The Deglet Noor palm shown in figure 6 after the number of leaves had been reduced to 64 by pruning off the lower ones to clear the tops of the bunches of dates. Such severe pruning tends to lower the bearing capacity of the palm and usually results in a light crop the following year unless the number of bunches of fruit is proportionately reduced.

pollen. A simple way of handling small lots of pollen is to cut off the strands and spread them in a thin layer on paper in shallow trays. For handling large quantities of pollen, screen-wire shelves or trays with screen-wire bottoms will be found convenient, with some container beneath to catch the dry pollen that falls from the flowers. The flowers turn dark in a few days, but the pollen remains good.

In drying and storing pollen high temperatures should be avoided. If exposed to direct sunlight in chambers under glass

FIGURE 8.—Removing spines from date leaves.

or placed near a hot stove, pollen soon deteriorates and loses its viability (*22*). On the other hand, in a dry room at moderate temperatures, pollen will keep satisfactorily for the duration of the pollination season (2 or 3 months). Pollen held over from one season to the next under such conditions has been found nonviable in numerous tests. However, pollen can be carried from one season to the next if well dried, placed in an airtight container, and held in cold storage. A household refrigerator at about 40° F. has proved satisfactory. Somewhat lower temperatures under conditions less subject to fluctuation are probably safer. To insure keeping the pollen dry, it may be placed in an open jar within a larger airtight container in the bottom of which

FIGURE 9.—Pollination of date flowers. *a*, Strands of male flowers being placed in the center of the female cluster. *b*, Freshly opened spathe ready for pollination. *c*, Flower cluster after pollination; a string is tied around the strands to hold male flowers in place and to prevent tangling in leaves. The tips of all strands in the female cluster were cut back in the first operation of fruit thinning, which is usually done at this time.

are kiln-dried lumps of calcium chloride (anhydrous calcium chloride). About 1 pound of calcium chloride should be adequate for each 5 pounds of pollen (*3*).

Selection of Male Palms

Formerly seedling male palms were used more or less indiscriminately; but growers are now beginning to realize the value of selection, and there is an increasing tendency to purchase male offshoots rather than attempt to grow the palms from seed. One good male should furnish pollen sufficient for 50 or more female palms. The owner of seedling males should keep a record of all that are considered good enough for further propagation and check their annual performance with regard to the following points, which will enable a prospective purchaser of offshoots to evaluate a given selection.

Time of blooming.—Obviously, if fresh pollen is to be used, the male must bloom as early as the females. However, it is well to bear in mind that unless male palms are grown under the same favorable cultural conditions as the fruiting palms they cannot be expected to flower and produce normally. Male palms are often crowded in fence rows and not given sufficient irrigation. Palms will flower earlier if planted on the south side of the garden or where there is maximum exposure to sunlight.

Number and size of flower clusters.—With more and larger inflorescences, fewer male palms will be required.

Flowers and pollen.—Flowers that tend to adhere to the strands without shedding easily are to be preferred, especially if the fresh flowers are to be used in pollination; and the pollen will be better conserved if the petals are not wide open when the spathe first splits. The flowers should contain an abundance of pollen.

Compatibility.—In some varieties a better set of fruit will be produced by pollen from some males than by that from others, this being apparently a matter of compatibility between male and female varieties. The prospective purchaser of male offshoots should know that the pollen in question has been used satisfactorily on the varieties he is growing.

Metaxenia, or the direct effect of pollen on the fruit.—Within certain limits the pollen used affects the size of the fruit and seed and the time of ripening (*35, 38*). As size of fruit is affected to a much greater extent by fruit thinning, generally practiced in commercial date culture, the effect of pollen on size is not of such immediate importance.

The changes in time of ripening that may result from the use of different pollens are not likely to be more than a few days where fruit ripens early, but they may be as much as several weeks where it ripens late, because of the retarding effect of cool weather on ripening. In most localities within the warmer desert areas best suited to date culture, the grower need not be much concerned about the effect of pollen on time of ripening. However, in a few localities the late ripening of late varieties has been somewhat of a problem, and pollen causing earlier ripening has been used to considerable advantage. For example, in one Deglet Noor garden where the fruit was not all harvested until March 15 with the pollen generally used, the application of a different pollen resulted in the completion of the harvest by the end of December (*58*). In marginal date districts, where there is usually insufficient summer heat for the proper maturation of fruit, the use of pollen causing earlier ripening has in a number of instances resulted in the ripening of fruit where it had never before reached maturity. Pollens from several different Fard seedling males have been found to produce this earlier ripening. Whether the crop would be benefited by earlier ripening in any particular case can be determined only by tests in which the pollen already in use is compared with one known to produce early ripening.

FRUIT THINNING

Fruit thinning is necessary (1) to increase the size, improve the quality, and prevent delayed ripening of the dates; (2) to reduce the weight and compactness of the bunches; and (3) to insure adequate flowering the following year (*44*). Since the

fruit may be thinned either by reducing the number of fruits per bunch (bunch thinning) or by reducing the number of bunches per palm (bunch removal) and since in commercial practice both operations are employed, it is necessary to give special attention to each of them.

Bunch Thinning

Every bunch should be thinned by removing not less than one-half and not more than three-fourths of the total number of flowers or fruits that it carries under normal conditions. A bunch may be thinned by reducing either the number of fruits per strand or the number of strands; in practice it is generally desirable to use both methods in proportions depending on the variety and on other considerations. With the Deglet Noor and other long-strand varieties (figs. 10 and 11), the tips of all strands should be cut back enough to remove about one-third, or slightly more, of the total number of flowers or fruits. In addition, entire strands should be cut out from the center of the bunch, enough to remove from about one-third of the total number on most bunches to about one-half on very large bunches. On mature Deglet Noor palms, bunches thinned in this way will normally carry at maturity from 20 to 35 dates per strand on 30 to 50 strands per bunch, and the ripe fruit picked per bunch will vary from 15 to 25 pounds depending on the size of the cluster before thinning, the percentage of fruit set, and the amount of thinning as determined by considerations mentioned later.

Varieties like Halawy (figs. 12 and 13) and Khadrawy have shorter and more numerous strands than Deglet Noor and consequently less should be cut from the tips and more entire strands removed from the center of the bunch; in such varieties very satisfactory results have been obtained by cutting back the tips of strands only enough to even up the end of the bunch, removing about one-tenth to one-sixth of the total number of flowers or fruits in this way, and cutting out entirely about one-half or slightly more of the total number of strands from the center of the bunch. Under some conditions it may be preferable to omit cutting back the tips and to do all the thinning by cutting out center strands up to about two-thirds of the total number. Such thinning is usually desirable when spreader rings are used in centers of bunches as is done in some localities where damp weather prevails during ripening.

Instead of cutting back strands, a few growers of fancy soft dates prefer to remove a certain proportion of flowers or fruits on the strands. This method reduces crowding of fruits on the strands, but it is not much used because of the time and expense involved.

Strands should be cut back at time of pollination (fig. 10). Cutting out center strands can be done at time of pollination with some of the earlier bunches of the long-strand varieties, but in most cases this operation must wait until the cluster has emerged farther. A few growers complete the thinning of early bunches when pollinating the later ones. A more conservative practice is to wait 6 or 8 weeks until the set can be determined, when bunches of more uniform size can be obtained by removing fewer strands if the set is poor, and vice versa.

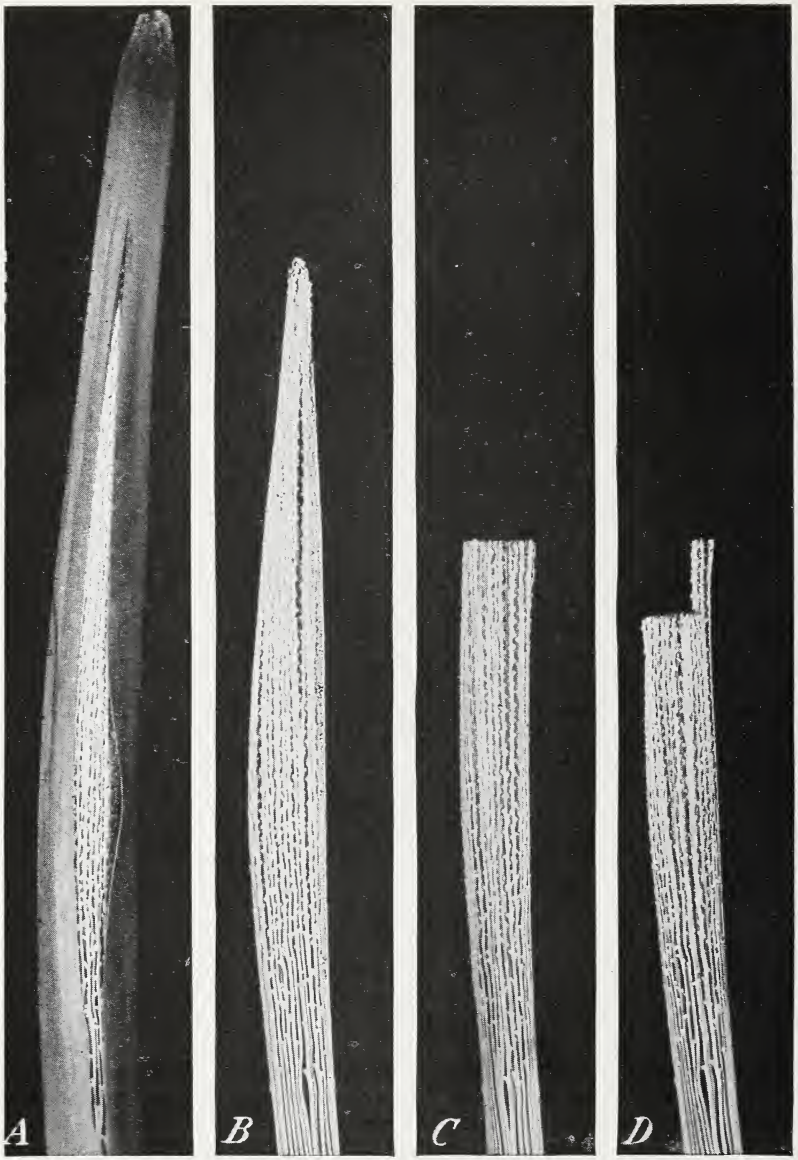


FIGURE 10.—First step in the bunch thinning of long-strand varieties of dates (Deglet Noor), at the time of pollination: *A*, Flower cluster with spathe breaking, indicating maturity; *B*, flower cluster after enveloping spathe has been cut away; *C*, flower cluster with tips of all strands cut back prior to pollination; *D*, flower cluster showing moderate cutting back (long strands), which removes about one-third of the flowers, and heavy cutting back (shorter strands), which removes about one-half of the flowers. (× about ⅓.)

The exact method and amount of bunch thinning must be determined by the grower after due consideration is given to variety, relative importance of size in grade, local weather conditions, and the effect on the fruit to be expected from different degrees of thinning by different methods.

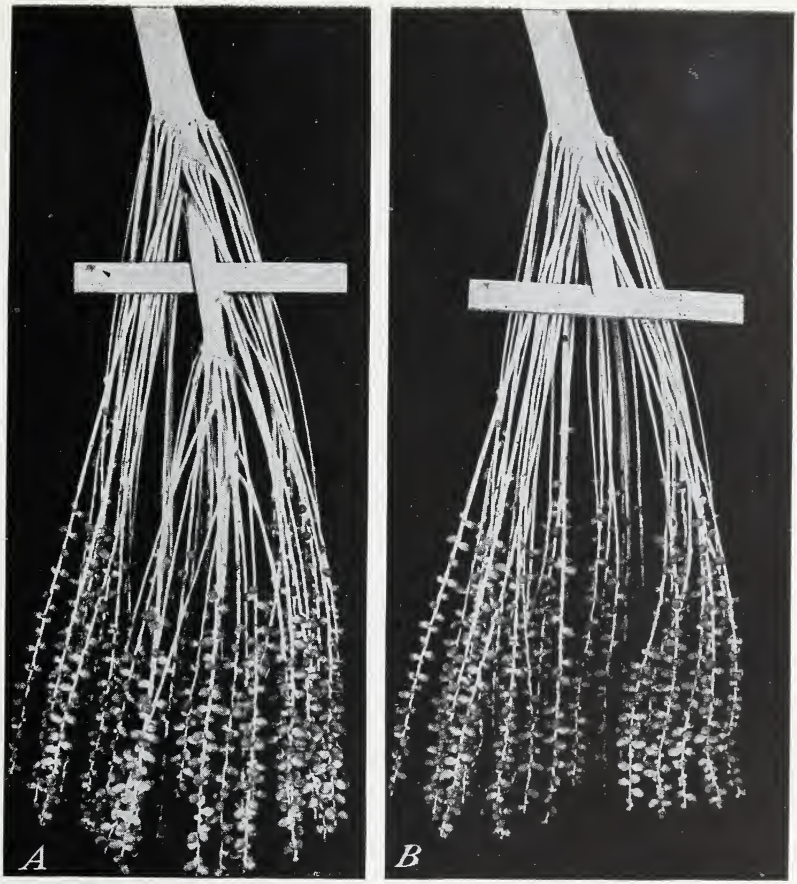


FIGURE 11.—Second step in the bunch thinning of long-strand varieties of dates (Deglet Noor). *A*, Bunch of dates cut back 6 weeks previously as shown in figure 10; strands in front of ruler must be entirely removed to prevent undue crowding of fruit. *B*, Same bunch after one-third of the strands have been removed by a single cut as shown. (× about ⅛.)

Recent studies (*41, 42, 45*) have brought out the following facts concerning bunch thinning, which should be considered in determining the method and amount. Any method of reducing the number of fruits per bunch will increase size and up to a certain point improve quality. To increase size, reducing the number of fruits per strand is slightly more effective (5 to 10 percent) than reducing the number of strands; but cutting back strands increases the susceptibility of fruit to checking, to blacknose (fig. 14), and, particularly in some of the softer varieties, to shrivel of ripe fruit, much more than does a comparable amount of thinning by cutting out strands. Overthinning increases puffiness and blistering (separation of skin and flesh). Slightly larger fruits are produced on the outside strands than on the inside ones. The larger the bunch the more fruit it can carry satisfactorily. The earlier thinning is done the more effective it is in increasing size. In periods of damp weather during ripening there is likely to be more trouble from fruit rot

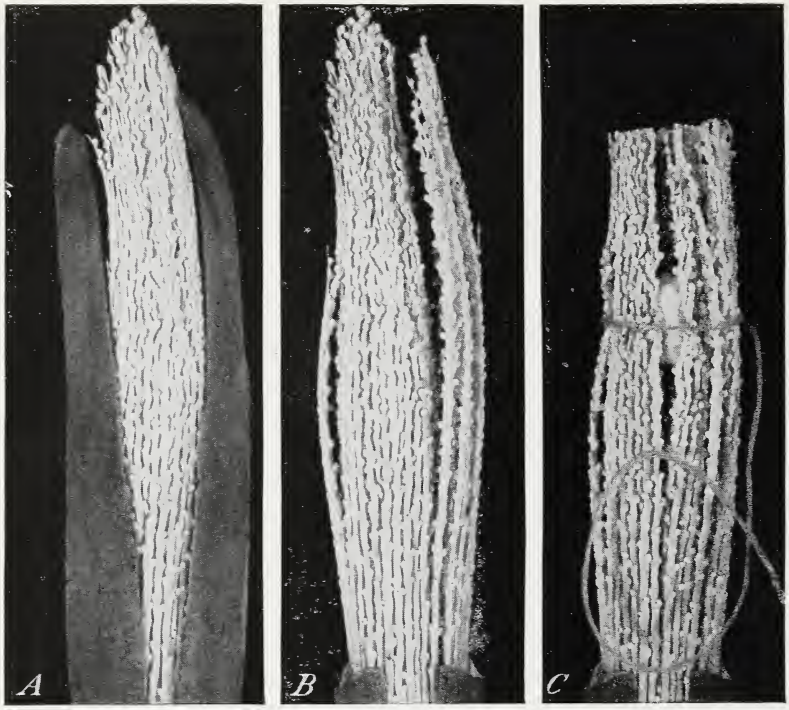


FIGURE 12.—First step in the bunch thinning of short-strand varieties of dates (Halawy), at time of pollination. *A*, Flower cluster just emerging from spathe; *B*, flower cluster with spathe cut away; *C*, flower cluster with just enough cut from the tips of the strands to remove about 15 percent of the flowers. Under some conditions it may be preferable to omit this and do all thinning by removing entire strands from the center. In *C*, note the cotton used in applying pollen and the twine around the strands to hold the cotton in place. (× about ¼.)

FIGURE 13.—Second step in the bunch thinning of short-strand varieties of dates (Halawy), about 6 weeks after pollination. *A*, Bunch of dates before second step in thinning; *B*, bunch showing strands that should be removed from the center; *C*, bunch with outer strands held apart to show appearance after thinning; half of the total number of strands were removed. If tips had not been cut back at time of pollination about two-thirds of the strands would have been removed. (× about 1/10.)

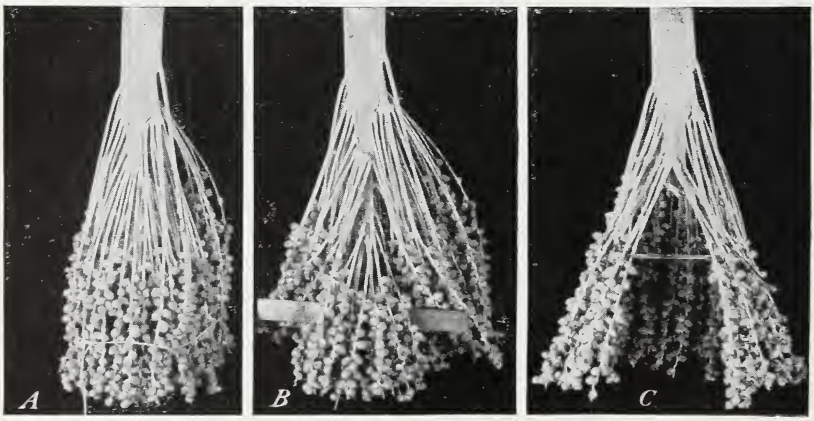


FIGURE 14.—Mature Deglet Noor dates that received different bunch thinnings: *A*, No thinning, which resulted in small fruit below commercial size and with a large percentage of shrivel; *B*, moderate thinning, which resulted in fruit of satisfactory commercial size and very little shrivel; *C*, excessive thinning, which resulted in serious reduction in yield, oversized fruit, and a high percentage of checking and blacknose. (× about 1/12.)

and souring in large bunches than in small ones, and where such conditions usually prevail it may be desirable to set an arbitrary upper limit on the size of the bunch regardless of the amount of thinning involved.

In order to obtain uniform size and quality it is important to thin all bunches uniformly. After the grower has decided upon the method and the proportions to be removed, it is desirable to check carefully from time to time the amount of thinning actually being done. It is suggested that the total number of strands be counted to determine how many entire strands are to be cut from the center. Likewise, if the total number of flowers on a strand of average length is counted, the tip of the strand can be cut back far enough to remove the desired percentage and then all strands can be cut back to the same point. A difference of only 2 inches in the length of the strand tips of a large Deglet Noor inflorescence may mean the difference between one-third and one-half of the total number of flowers or fruits. Removing one-half of the flowers from the strands may result in 15 to 20 percent more blacknose than removing only one-third.

Bunch Removal

It is usually necessary to remove some entire bunches because they are undesirable or in order to reduce the total crop. If a palm is allowed to bear too much fruit one year, it will not produce enough flowers for a normal crop the next season. The first one or two flower clusters of Deglet Noor are quite commonly small with short strands, a long fruiting head (area from which strands branch), and a long, slender fruitstalk; and if there is an excess number of bunches, these are commonly removed in favor of the larger and later ones. On the other hand, the last few flower clusters that appear are often so small that they are left unpollinated and removed later. When pollinated the fruit

is quite normal, but when the number of larger bunches is sufficient to carry all the fruit that the palm should bear it is not economical to pollinate, thin, and bag small bunches with less than 6 or 8 pounds of fruit. Bunches with very poor sets or with broken fruitstalks should also be removed.

The amount of fruit that a given palm can safely carry depends on the age, size, vigor, and variety of the palm and the number of good green leaves that it carries. A large offshoot may begin flowering the year after planting, but it is not good practice to leave any fruit for the first 3 years, as growth is more important than fruit production until the palm is well established. If the young palm is making normal growth, one or two bunches may be left the fourth year; and commercial production may begin the fifth year with three or four bunches and a total of 30 to 50 pounds of fruit. Production should increase yearly until the maximum number and size of leaves are reached; this is usually at 10 to 15 years depending on variety and growing conditions. The number and the size of the leaves are the best index of palm vigor and fruiting capacity, and differences in this respect explain some of the differences between varieties as regards yield.

Preliminary studies indicate that with the Deglet Noor, and probably with most other varieties, a palm under favorable conditions may carry 1 moderately thinned bunch of fruit for each 8 to 10 leaves without reducing the number of flower clusters the following year. On this basis, the safe load for a normal mature palm would be 10 to 14 bunches or somewhat more if the palms are exceptionally vigorous and the leaves larger and more numerous than average. Records from some of the better commercial date gardens show yields from healthy palms in full production of about 2 pounds, sometimes as much as 3 pounds, of fruit for each green leaf. If the bunches have been thinned by removing a certain proportion of the total number of flowers or fruits, an estimate of the total load by the leaf-bunch ratio method has the advantage of allowing for differences in size and vigor of palms. If the palm and leaves are small the flower clusters are also smaller, so that there will be an approximate adjustment to the actual leaf area.

In attempting to estimate the crop that a palm should carry, a word of caution is necessary. Irrigation, fertilization, and probably other factors also affect fruit production. While experimental data are as yet insufficient to evaluate these factors fully, there is considerable evidence that insufficient water may reduce the number of flower clusters and limit the bearing capacity of the palm regardless of leaf-fruit ratio. Furthermore, palms that are underirrigated throughout the year will usually carry a smaller number of leaves because of the premature death of the older leaves. Since the grower naturally wants the highest yield of fruit consistent with prevailing standards of quality, it is suggested that individual palm records be kept of the total number of flower clusters produced and bunches carried each season. A decline in flower production is usually evidence that either the number of leaves or the water supplied to the palm during the preceding season was not adequate for the crop carried. On the other hand, an increase in number of flower clusters

FIGURE 15.—Trunk of date palm, white tape marking 1 of the 13 spirals in which leaves are arranged.

produced would be justification for leaving more fruit on the palms than had been carried the previous season.

Because of their more or less symmetrical arrangement, it is usually possible to estimate fairly quickly the total number of leaves on a date palm. The leaves are grouped in 13 nearly vertical columns, on some palms spiraling slightly to the left and on others to the right (fig. 15). The number of leaves in 1 of

these columns multiplied by 13 gives the approximate number of leaves on the palm. To allow for uneven pruning at the base, counts may be made on opposite sides and divided by 2.

PULLING DOWN AND SUPPORTING THE BUNCHES

With most commercial varieties after the pollination season, the bunches are pulled down through the leaves and the fruitstalk is tied to the midrib of one of the lower leaves. This prevents much scarring of the fruit and lessens the later danger of fruitstalk breakage by supporting the bunch as its weight increases. Some of the smaller and later bunches will not be out far enough to tie when the earlier bunches are ready for this operation, but they can be taken care of 3 or 4 weeks later, when it is desirable to adjust some of the first ties to accommodate further elongation of the fruitstalk or movement of the bunch. The second part of bunch thinning—cutting out center strands—is usually done when bunches are pulled down.

Pulling down bunches should be done with care to avoid breaking fruitstalks. It should not be done until the fruitstalk is long enough to permit some of the curvature to be distributed so that the base will not take all the stress; if it is not done until after the fruitstalk has entirely ceased elongation, there appears to be more danger of breakage. Broken fruitstalks are an obvious loss, but partial breaks are often an unsuspected source of shriveled or low-grade fruit. The fruitstalk grows rapidly for the first few weeks after pollination. During this time it is quite soft and pliable and is easily bent at the base.

A procedure followed by some growers, and one safer for miscellaneous varieties, is to start the earlier bunches down from time to time while pollinating the later ones. If once or twice during the early growing period the fruitstalk is pulled down as far as is safe without danger of breakage, most bunches with long fruitstalks will later come down satisfactorily even though they are not tied down. The few bunches that seem likely to give trouble in this respect may often be held down by attaching one end of a date leaflet to the fruitstalk. The bunch does not usually require support until the fruit has attained about three-fourths of its full size; and with some varieties "tying up" at that time may be more satisfactory than "tying down" at an earlier stage.

With young palms, bunches are held off the ground by attaching the fruitstalk to one end of a wooden stake.

FRUIT GROWTH IN RELATION TO DAMAGE FROM RAIN AND HIGH HUMIDITY

Arabs distinguish four stages in the growth and ripening of the fruit—kimri, khalal, rutab, and tamar—that are important in relation to damage from rain and high humidity. In the first stage (kimri) the fruit makes its most rapid growth in size and is distinguished by its green color. Fruit enters the khalal stage when it has about reached its maximum size and the green color of the growing period is replaced by a shade of red or yellow or a combination of the two colors characteristic of the particular

variety at this time. Fruit enters the rutab stage when the tip first begins to soften or lose its khalal color. When the fruit has fully ripened, and dried until it will keep without spoiling, it is in the tamar (cured) stage.

Occasional wet weather appears to have little effect upon the fruit during the early growing stage. The occurrence of periods of high humidity immediately prior to the khalal stage, while the fruit is still green and just beginning to fade a little in transition, often results in minute superficial breaks, or checks, in the skin. The abundance of these checks and the manner in which they occur (transverse, longitudinal, or irregular) vary in the different varieties. In some varieties, such as Deglet Noor, checking occurs chiefly near the tip of the fruit and when severe is usually followed by a darkening and shriveling of the tip, known as blacknose (*23, 36, 37*).

After the fruit acquires the khalal color checking no longer occurs. In this stage contact with water produces deeper and longer breaks or cracks in the skin and flesh beneath. This cracking is more severe when it occurs in the latter part of the khalal stage; it is then sometimes called splitting. In some varieties such as Deglet Noor, severe cracking is accompanied by irregular curling back of the skin and outer flesh, known as tearing. If tearing is not excessive, the torn portion may return to its normal position when dry weather follows rain but the grade of the fruit is lowered. Humid weather during the khalal stage also favors the development of various fungi that attack the fruit and cause serious spoilage from rot.

After the flesh softens in the rutab stage, the skin does not break readily upon contact with moisture, but the fruit absorbs moisture and tends to become sticky, less attractive, and more difficult to handle. The increase in moisture content and the interference with normal drying, or curing, are conducive to fermentation, or souring, which is often a source of considerable loss.

After the tamar stage is reached, rain and high humidity cause little damage to the fruit unless it is neglected after prolonged contact with water and excessive absorption of moisture.

PROTECTING THE FRUIT FROM RAIN

With most varieties and in most districts it has been found desirable to protect the fruit from rain by covering the bunch during the ripening season. Paper bags or tubes attached to the fruitstalks immediately above the bunches, with the lower ends left open, are most extensively used. Waterproof cloth covers of various types are being tried in some localities. Covers are usually put on after the fruit begins to acquire its khalal color.

Covering the bunches prior to the khalal stage may increase checking and blacknose, since it affords no protection from atmospheric humidity but rather serves to increase it by reducing ventilation within the bunch. However, after the covers are attached the sides may be turned under and rolled up so as to allow free air circulation about the fruit until rain threatens, at which time they should be pulled down; this is not often practicable on account of the labor involved except with young palms or

small plantings. The importance of bunch ventilation increases with the frequency of showers and periods of high humidity during the later stages of fruit growth and ripening. Bunch thinning promotes better aeration of fruit under the covers, especially when most of the thinning is done by removing center strands.

Rings, or spreaders, made of heavy wire are sometimes used to keep the centers of the bunches open as the fruit sizes up. To be of any value in reducing blacknose and checking, the rings must be inserted before the fruit reaches the khalal stage; but they also help later in reducing fermentation and rot in the centers of bunches (*11*). Although not yet used extensively enough to be standardized, rings vary from 6 to 12 inches in diameter and those of a many-pointed-star shape seem to remain in place better than perfect circles.

WHEN TO PICK DATES

As all the dates on any one bunch do not ripen at the same time, several pickings are usually required to harvest the fruit during a season, which lasts from 3 to 4 weeks for early varieties to 2 or 3 months for late ones. The dates of a few varieties are not picked individually. Dry dates like Thoory are left until all the fruit is fully ripe, and then the entire bunch is cut. With the semidry variety Zahidi, entire bunches are also sometimes cut after all the fruit is ripe, and then the drier fruit is softened by hydration.

The stage of maturity at which fruit is picked depends on local weather conditions, consumer preference, and variety. Where or when the climate is favorable, it is preferable to leave the fruit of most varieties on the palm until it reaches the stage of maturity at which it is to be consumed or stored. From the consumer's standpoint, date fruit may be considered ripe when it becomes palatable. Actually the changes associated with ripening and the period during which fruit may be consumed extend from the peak of the khalal stage, when the fruit has its most intense red or yellow color and maximum weight, to the final tamar stage, when it has lost the greater part of its moisture content and will keep without special attention to storage. Arabs eat large quantities of dates of many varieties in the khalal stage. At least two of the varieties of dates imported into the United States (Barhee and Braim) are so palatable in this stage that even here some people, if given the opportunity, might acquire a taste for them. Most varieties, however, are entirely too astringent in the khalal stage for the American or European palate.

Loss of astringency is associated with loss of khalal color. Loss of moisture also begins at the same time but continues through to the tamar stage unless checked by high humidity, either as the result of atmospheric changes while the fruit is still on the palm or as affected by the temperature and the container in storage. Many people find the fruit very appetizing immediately after the loss of the khalal color, while it is still plump and the moisture content very high. However, fruit in this condition is difficult to handle, and if it is to be marketed it must be either consumed immediately or placed in storage at a very low temperature. For

dessert purposes, most people prefer dates after they have passed this plump ripe stage.

The most desirable stage of maturity for consumption varies with the variety. The fruit of some varieties and of many seedlings contains such a high percentage of moisture that if dried sufficiently to keep without low-temperature storage, little substance will be left. Furthermore, some varieties ferment, or sour, more readily than others. To put the fruit on the market in just the proper condition is the problem of both grower and packer. With the better kinds of soft dates, the best keeping quality is attained when the fruit has lost its watery consistency and has become pliable to the touch but not tough.

With miscellaneous seedling palms or in any locality where dates have not been previously tested, the stage of maturity at which the fruit should be picked, either for immediate consumption or for storage, can be determined only by observation and experimentation.

HARVESTING METHODS

For picking soft dates, which require more care in handling than the firmer types, shallow trays should be used and the fruit should be not more than two or three layers deep to avoid crushing and bruising. The firmer or semidry varieties may be picked in deeper containers, buckets being commonly used.

Picking becomes somewhat of a problem as palms become older. Stepladders are generally used as long as the bunches are not more than 10 or 12 feet above ground. Beyond that point, several different aids to picking are used. A few growers attach picking platforms to the trunk of the palm a few feet beneath the foliage. Such platforms must be raised about every 2 years, but the chief drawback to their use is the expense of installation. Some growers use the Laflin track ladder. This consists of a straight ladder, the base of which is mounted on flanged wheels moving on a circular track around the palm and the top of which leans away from the palm but is held to it by a chain passing around the trunk. Probably the most widely used equipment for harvesting the fruit from very high palms is the picking belt; a chain passed around the bases of three or four green leaves and attached to the belt holds the workman suspended beneath the leaves while he braces his feet against the trunk of the palm and picks with both hands (fig. 16).

For Deglet Noor fruit several buckets are usually taken into a high palm; each is let down in turn by a rope attached to the handle with a large hook, which is easily disengaged after the bucket touches the ground and the rope slackens. For picking soft dates from high palms some growers use cloth-bottom trays suspended beneath the bunches from hooks attached to the leaves. Of course, straight ladders must be used to reach the crowns of these high palms. Extension ladders are used for high palms, and some growers simplify the problem of carrying very long ladders around to reach extra-high palms by attaching a straight ladder permanently to the trunk to cover the 10 or 20 feet immediately below the crown.

FIGURE 16.—Harvesting dates, showing picking belt in use.

PACKING-HOUSE MANAGEMENT

In commercial date areas, the fruit of most growers is handled either through a cooperatively owned packing house or by special arrangement with a privately owned plant. The grower who plans to handle his own fruit will find it to his advantage to visit the larger date-packing houses and study the equipment and machinery used. Only brief mention of the essential operations can be given here, together with a few suggestions, included primarily for the benefit of the owners of small plantings located some distance from an established packing house. The preparation of dates in any quantity for market involves the following steps, usually in the order named: Fumigation, cleaning, grading, artificial ripening, dehydration, hydration, packing, and storing.

FUMIGATION

The fruit is taken to the packing house and fumigated as soon as possible after it has been picked. The fumigating room is generally provided with 2 openings to permit the transfer of fruit from the receiving room into the main part of the packing house without danger of reinfestation. All outside openings of the pack-

ing house should be provided with screens having not less than 36 wires to the inch in order to protect the fruit after fumigation.

Methyl bromide has now generally replaced other fumigants. Carbon disulfide, cyanide, and ethylene oxide, used at various times in the past, have been effective in controlling insects but have been abandoned because of dangers involved in handling.

Methyl bromide is a very poisonous gas and, being odorless, it should be handled with extreme caution and only by responsible persons who are thoroughly familiar with fumigation practices. The fumigation room should be so located that direct outside ventilation can be provided for the removal of the toxic gas.

A relatively safe, nonflammable, liquid fumigant, for use with small lots of fruit and improvised facilities, is a mixture of 3 parts of ethylene dichloride and 1 part of carbon tetrachloride (*6*). It is used at the rate of two-tenths of a fluid ounce, or slightly less than 2 teaspoonfuls, per cubic foot of fumigator space, and the time required is 12 to 18 hours. The fumigant is placed in a shallow container or poured on a thick pad of toweling above the fruit in trays or boxes, and the fumes, which are heavier than air, will penetrate all parts of a tightly closed container.

Cleaning

Most dates are cleaned by passing them over damp toweling. Mechanical shakers lined with toweling and sloping toward one end are used in packing houses for the semidry and firmer soft dates. In some types of equipment the dates first pass over a coarse screen through an air suction, which draws off dust, dirt, and debris. Trays operated by hand can be used for small lots of fruit. Soft dates are sometimes cleaned by being spread in a thin layer on screen-bottom trays and sprayed with water, but they must be dried promptly afterward to prevent souring.

Grading

Grading is necessary to remove culls and to separate the fruit into lots of uniform ripeness, consistency, size, and appearance for further handling. In the larger packing houses a moving belt conveys the fruit from the cleaner and facilitates sorting by the graders (fig. 17). Small lots of fruit, particularly of the soft varieties, are often graded on tables.

Artificial Ripening

Because of unfavorable weather or a consumer preference developed under such conditions, some fruit may be picked before ripening has progressed far enough to be completed without artificial heat. For such fruit, maturation rooms or chambers are provided, where uniform temperatures from 80° to 120° F. can be maintained with some provision for humidity control (*1, 6, 21, 24, 25, 51, 57*).

The higher temperatures are required for the less mature fruit (usually retaining more or less khalal color), for which a higher relative humidity during ripening is also necessary. Nearly ripe fruit (with little or no trace of khalal color but retaining more

or less unsoftened flesh around the seed and at the base) may not require artificial heat when temperatures of 80° to 100° prevail early in the season. From several hours to several days may be necessary to complete ripening, lower temperatures and less mature fruit requiring longer periods. The higher the ripening temperature the darker the fruit is likely to be. Fruit of the Deglet Noor variety is picked after practically all the khalal color has disappeared, and in the packing house it is not exposed to temperatures above 95°.

Because of the great variation between different varieties of dates and the varying maturity and moisture content of different lots of fruit picked under different seasonal conditions, it is not possible to outline any general procedure that will not have to be continually modified according to the experience and judgment of the operator.

Owners of dooryard palms sometimes ripen small lots of fruit by a few days' exposure to the sun either in glass jars with lids loose or in covered trays.

Dehydration

Dates with a very high moisture content must be dried, unless they are to be consumed immediately or placed in low-temperature storage. The maturation room may be used also for drying if provided with ventilators and equipment for expelling the moist air and circulating drier air from outside.

Small lots of dates are often dried satisfactorily in any dry, well-ventilated room by being placed in shallow, screen-bottom trays, stacked so as to provide air movement between and around the trays. In clear weather such fruit may be handled outdoors if protected from insects.

Hydration

Delayed picking, inadequate irrigation, or an unusually dry season may cause a certain proportion of the crop of the firmer types of dates to become too dry to suit consumer preference. Since the fruit readily absorbs moisture from a humid atmosphere, packers take advantage of this fact to improve the consistency of some of the drier dates—a process called hydration (*5, 50*). High temperatures accelerate moisture absorption. In commercial packing houses, special processes in which steam is used for hydration have been developed.

Packing

Dates to be sold in bulk are mostly packed in 15-pound lugs if of the firmer type and in shallower, 10-pound flats if of the soft type. Smaller containers are not yet standardized but are varied to suit the purpose and demands of the packer or market. If the moisture content has been lowered sufficiently to prevent souring, dates may be kept in tight cans or glass jars, which will exclude insects and prevent further drying. Cardboard and light wooden containers are used satisfactorily for fruit of higher moisture content.

Storing

Only fruit that has been properly dehydrated can be kept for any length of time without refrigeration (*4, 24, 51*). The higher

the moisture content of the fruit the more perishable it is. The lower the storage temperature the longer the fruit can be held without deterioration. Freshly ripened dates, which begin to show some deterioration after several weeks in a household refrigerator (about 40° F.), have been kept for a year at −30° with no apparent change.

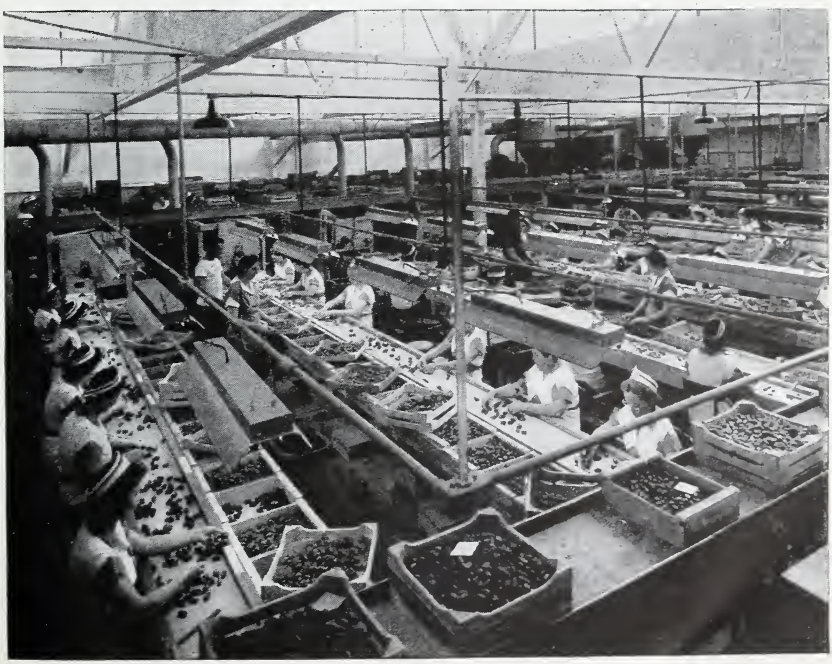
The appearance of the fruit of many varieties in ordinary storage is often marred by the formation of sugar spots beneath the skin and within the flesh. Fruit has been found to sugar-spot much worse when the moisture content is between 22 and 33 percent than when it is either above or below this critical range (*49*). Sugar-spotting may be delayed or prevented entirely by temperatures sufficiently low.

DISEASES AND PESTS

There are no serious insect pests of the date palm in the United States at the present time. The parlatoria date scale *(Parlatoria blanchardii* (Targ.)), probably the most dangerous insect enemy of the date palm, was introduced with early importations of offshoots and for a time seemed to threaten the future of the industry, but it is now believed to have been completely eradicated by Federal and State agencies. No considerable damage from any of the other insects listed is likely to occur unless control measures are neglected.

One disease, omphalia root rot (*10*), though it has not as yet assumed serious proportions as far as the industry as a whole is

FIGURE 17.—Grading dates in a modern date packing house. (Photographed by Field Studios.)



concerned, seems to have grave possibilities unless it is carefully watched and its further spread prevented by restricting the movement of offshoots from infected areas. Only Deglet Noor, the principal commercial variety, appears to be seriously affected. Rots cause occasional unpredictable heavy losses after prolonged exposure of the fruit to high humidity during the ripening season. Thus far these losses have been only slightly minimized by bunch management and preventive measures. Considerable study of date diseases as they occur in California and Arizona has been made by the State agricultural experiment stations of the two States. The Citrus Experiment Station at Riverside, Calif., has given particular attention to problems of this kind. For detailed information on diseases reference should be made to certain publications cited (*9, 10, 11, 12, 19, 23*).

Diseases

Omphalia root rot, or decline disease, is caused by two related fungi (*Omphalia pigmentata* Bliss and *O. tralucida* Bliss), which attack the roots and tend to spread to other palms from year to year. The more obvious visible effects of this disease are loss of vigor, stunted growth, and eventual failure to fruit. According to Bliss (*10*), the most important symptom for identification is the condition of root rot, as the effects of growth and fruiting are believed to be secondary. Palms of the Deglet Noor variety, which is highly susceptible to omphalia root rot, become worthless a few years after infection. Other common varieties appear resistant, although many of them may be affected to some degree. This disease, which was first noted in 1921, is now found in more than 25 date gardens in the Coachella Valley. Thus far, total fruit production has not been materially reduced, but in some individual gardens the losses have been serious. No curative measures have been discovered, but infections may be eradicated by means of soil disinfection with carbon bisulfide. Since the disease is spread from place to place on offshoots from affected palms, growers should obtain offshoots only from healthy palms well removed from areas of infection.

Diplodia disease is caused by *Diplodia phoenicum* (Sacc.) Fawcett and Klotz, a fungus that sometimes affects leafstalks and offshoots. It causes leaves to show dull reddish- or yellowish-brown streaks in the midrib, and it may cause offshoots to die. It is seldom serious in well-cared-for gardens. Fawcett and Klotz (*19*) recommend spraying infected palms and offshoots with ammoniacal copper carbonate, after first removing infected leaves and dead tissues and taking the further precaution of disinfecting pruning tools by dipping them in a solution of formalin after each palm is treated.

Black scorch is a fungus disease caused by *Thielaviopsis paradoxa* (De Seyn.) Hoehn.[4] It does most damage to young leaves, which become stunted, distorted, and blackened as though scorched by heat. Inflorescences and fruitstalks appearing among the diseased leaves will also be affected by the fungus. In the United States, the Thoory variety seems to be the most

[4] Perfect stage is *Ceratostomella paradoxa* (De Seyn.) Dade.

susceptible. Usually the disease develops only on occasional palms, which generally outgrow the trouble.

Graphiola leaf spot, or false smut, is caused by *Graphiola phoenicis* (Moug.) Poit., a fungus that attacks the leaves, forming numerous small dark-brown or black cylindrical elevations from which yellow spore dust escapes. Severe infections may affect adversely the growth and fruiting of the palm by causing early death of leaf tissue. However, this disease is not of economic importance in the present date-producing districts of California and Arizona, being apparently held in check by low humidity. In the southern part of Texas, where infections are more severe, bordeaux spray has been found beneficial (*59*).

Fruit rots often cause considerable loss when humid weather occurs during the ripening season. Under such conditions various fungi may develop on the fruit and cause spotting, dropping, and rotting (*12*, *19*). Although investigations thus far have failed to show practical means of preventing such losses, damage may be reduced by better ventilation of the bunches (see section on Protecting the Fruit from Rain, p. 29). Where humid weather occurs more or less regularly during the fall, growers in some districts avoid some loss by picking dates just before they are fully mature and allowing them to ripen in warm maturation rooms.

Blacknose has been discussed in the section on Fruit Growth in Relation to Damage from Rain and High Humidity (p. 28). Blacknose mars the appearance and lowers the grade of the fruit and may produce a certain percentage of culls. While the occurrence of blacknose is related primarily to seasonal conditions resulting in high humidity at the time the fruit is susceptible to checking, increased humidity around the fruit resulting from any cause will aggravate the condition. Hence, interplantings and even cover crops and tall weed growth have been observed to increase the amount of blacknose unless the bunches are well above the top level of the interplantings. Checking and blacknose may be reduced by providing better ventilation of the bunches and by avoiding overthinning (see p. 23). Typical blacknose occurs in only a few varieties, of which, unfortunately, the Deglet Noor is outstanding.

Crosscuts or transverse notches sometimes occur in fruitstalks. These are usually abrupt, smooth breaks in the tissue in the lower portion of the fruitstalk as though it had been cut with a sharp knife. Fruit on that part of the bunch in line with the crosscut is usually stunted and of poor quality. Often the fruitstalk breaks because of this weakness and all the fruit may become shriveled and worthless. The cause of crosscuts in fruitstalks, and of the very similar V-shaped notches often seen in leaf bases, is not known. Bliss (*9*) found that affected fruitstalks sometimes have internal cavities similar to the external and visible breaks in the tissue. Hence, it appears that micro-organisms are not involved and that the trouble may be the result of some physiological weakness or a mechanical strain in the tissue during the period of its most rapid growth. Fortunately, crosscuts in the fruitstalks do not often occur in the principal commercial vari-

eties. The trouble has been serious on old palms of the Sayer variety.

Pests

The date mite (*Paratetranychus simplex* (Banks)) sometimes causes serious drying and scarring of the fruit surface during the growing stage (*52*). Although the mite itself is too small to be readily seen, its presence may be suspected from the fine, dense web with which it covers much of the surface of the fruit. The mite is readily controlled with sulfur dust, which should be applied about the last of May or the first of June.

The dried-fruit beetle (*Carpophilus hemipterus* (L.)), sometimes called the two-spotted fig beetle, is the most troublesome insect during the date harvest. The beetle is killed by fumigating the fruit after it is picked but before it is stored or packed. The beetle prefers the softer fruit and breeds freely in sour and rotting dates even when buried in the soil. The removal of dropped fruit will reduce the number of beetles.

The Indian-meal moth (*Plodia interpunctella* (Hbn.)) is seldom noticeable in the field, but it is a serious pest of fruit in the packing house unless controlled by fumigation.

The saw-toothed grain beetle (*Oryzaephilus surinamensis* (L.)) is likely to find its way to fruit stored under ordinary conditions. Periodic fumigations and well-insulated storage rooms, preferably cold storage, are the only safeguards.

The red date scale (*Phoenicococcus marlatti* Ckll.), also of Old World origin, occurs in all localities where dates have been planted commercially in Arizona and California. This scale attracts little attention, as it is found mostly underneath the fiber behind overlapping leaf bases, around the bases of fruitstalks, and not infrequently on roots underground. It seldom appears to cause appreciable damage to palms growing under favorable conditions. However, when experimental plantings of dates are made in new areas where the climate is milder or more humid than in the established commercial regions, the possibility that the red date scale might cause more damage should be considered.

The date bug (*Asarcopus palmarum* Horv.), one of the lantern fly family (Fulgoridae), is a small, reddish-brown insect, slightly larger than the grape leafhopper, which occasionally attracts attention by the considerable amount of honeydew it excretes on the bud leaves and around the bases of fruitstalks. Only in very rare instances has it appeared to cause enough damage to warrant treatment. Satisfactory control may be obtained either by sulfur-nicotine dust or by 40-percent nicotine sulfate spray in strength of 1 to 500, with 0.5 percent of soap (*52*).

Nicotine sprays are poisonous and must be handled carefully.

In the lower Rio Grande Valley of Texas, date palm offshoots and nursery palms of other species are occasionally injured by the large, native rhinoceros beetle (*Strategus julianus* Burm.), which bores into the palm just below the soil surface. Nurserymen in that district flood the beetles out of their holes with water, pick them up, and destroy them. *Dinapate wrighti* Horn, another large beetle that infests the California native fan palms in the canyons and foothills bordering Coachella Valley, has been known

to attack a few date palms in Palm Springs, but the amount of injury has been questionable and so far the beetle has not been found in any commercial date planting. The fruit-bearing strands of a date bunch are sometimes damaged by the girdled cicada (*Tibicen cinctifera* (Uhler)), which may partly sever a strand with a row of its egg punctures, but the total damage is usually negligible.

Protection from Birds and Insects

Birds and insects of many kinds are attracted by dates and are likely to be particularly troublesome during the ripening season in localities where there are relatively few palms. The bags used for protection from rain (p. 29) usually serve also to prevent damage by birds, especially with the firmer types of dates. With soft dates, protection is usually provided by covering the entire bunch with cheesecloth or lightweight muslin.

VARIETIES

Selection

The commercial date industry in California and Arizona has been developed with varieties imported originally as offshoots from the date-growing regions of the Old World, principally Algeria, Egypt, and Iraq. In 1943 about three-fourths of the palms of imported varieties in the United States were Deglet Noor. The four next most important varieties combined, Khadrawy, Saidy, Zahidi, and Halawy, represented only about 15 percent. However, Deglet Noor has been a commercial success thus far only in the Coachella Valley, Calif., although it has been tried to some extent in nearly all localities where dates are being grown. Outside Coachella Valley, Khadrawy is the most widely grown variety but several others are of local importance in certain districts. Because of varying seasons and the importance which certain factors in culture and management sometimes have in successful fruit production, it requires many years to test thoroughly a new date variety and it is still too early to give a final verdict on some of the varieties represented in commercial plantings.

The prospective date grower should give careful attention to the selection of varieties likely to succeed in his locality. Climatic adaptations are of primary importance but must be considered with reference to soil conditions, yields, and present and future markets. Unless satisfactory tests have already been made in a given locality, the conservative procedure is to make a small planting of two or three varieties and extend acreage later on the basis of the behavior of these as they come into bearing. Some varieties that would not be adapted to tonnage production may be handled successfully on a small scale. In all the warmer desert sections of southern California and Arizona, the fruit orchard should have at least a few date palms for home use. In such plantings several different varieties of different types and dates of ripening are desirable.

Varieties of dates are generally divided into three groups ac-

cording to whether the flesh of the fruit, as it ripens under normal conditions in a favorable climate, is soft, semidry, or dry. The divisions are somewhat arbitrary, as consistency of flesh is affected more or less by climatic conditions and methods of handling, but the classification is convenient and widely used.

In the following list, which includes all the imported varieties planted to any extent in commercial gardens, there are several that have become fairly well established, a few that are increasing in favor, others that are declining in popularity, and some that are no longer being planted.

Description

Barhee (bär'hē).[5]—A soft date from Iraq, which has been increasing in popularity in recent years, although as yet it is represented in only a few commercial plantings in Coachella Valley, Calif. Fruit has been moderately damaged by rain and high humidity. Fruit small to medium; ovate to nearly round; yellow, ripening to amber, curing to a deep golden brown; has relatively little astringency in the khalal stage as compared with other varieties; late ripening. Heavy yields, frequently over 300 pounds per palm, are characteristic.

Dayri (dā'rĭ).—A semidry date from Iraq (*39*), which has attracted some attention because of the relatively slight damage sustained by the fruit during occasional humid weather, but there are only a few palms in commercial plantings in southern California and Arizona. Apparently best adapted to the heavier soils with ample irrigation. Fruit medium to large; oblong to oblong-elliptical; dull rose over a deep chrome yellow, ripening and curing to a dark, reddish brown, usually with a deeper color, almost black, at the base; the drier fruit is a light shade of dull red with a distinctive purplish tint; softer fruit attractive; drier fruit usually disappointing but said to be readily improved by commercial softening processes; midseason in ripening. Yields variable because of frequent failures to get a good set of fruit; 150 to 200 pounds per palm under favorable conditions.

Deglet Noor (dĕg'lĕt-nōōr).—A semidry date from Algeria; the leading commercial variety in the United States, grown chiefly in the Coachella Valley, Calif., in which locality in 1943 it accounted for about 85 percent of the total date acreage. In most parts of Arizona it has failed, largely because of the susceptibility of the fruit to damage from rain and high humidity, but in some instances failure was partly due to the fact that this variety is apparently not adapted to the heavier soils on which it has been planted. Fruit medium to rather large; ovate-oblong; coral red, ripening to amber, curing to a deeper brown; late ripening. Yields of 200 to 300 pounds per palm are harvested under favorable conditions.

Halawy (hà-lä'wĭ).—A soft date from Iraq; grown in all the date-producing districts, within which over a period of years it has been relatively little damaged by occasional rains and high humidity. Its principal disadvantage is a tendency to shrivel during ripening, although this objection is not usually serious on the heavier soils with adequate irrigation. Fruit small to medium; narrowly oblong; yellow, ripening to light amber, curing to translucent golden brown; early ripening. Yields 150 to 200 pounds per palm.

Hayany (hī-ăn'ĭ).—A soft date from Egypt, occurring in a few plantings in Salt River Valley, Ariz. Heavy losses of fruit have occurred during wet, unfavorable ripening seasons; does not cure readily and is best adapted to handling as a fresh date. Fruit large; oblong-elliptical; deep red, ripening to purplish black; early ripening. Yields 250 to 300 pounds per palm.

Iteema (ī-tē'mà).—A soft date from Algeria; fruit subject to serious spoilage when ripening occurs in wet weather; planted to some extent in Salt River Valley, Ariz. Fruit large; oblong-obovate; yellow, ripening to amber,

[5] The phonetic spellings given after variety names are not to be considered exact transliterations of the Arabic but merely attempts to give pronunciations that would be recognizable in the country of origin and at the same time conform as nearly as possible to established usage in the United States.

curing to darker brown; midseason in ripening. Yields 200 to 250 pounds per palm.

Khadrawy (ku-draw'wĭ).—A soft date from Iraq; the second most important commercial variety in California and Arizona; more widely distributed in this country than any other variety; fairly well adapted to a rather wide range of conditions. Palm smaller than any other commercial variety. Fruit small to medium; oblong, with broadly rounded apex; light yellow, ripening to greenish amber, curing to reddish brown; early ripening. Yields light, seldom more than 100 to 150 pounds per palm.

Khalasa (ku-läs'ȧ).—A soft date from southeastern Arabia; represented in a few commercial plantings in Salt River Valley, Ariz., and to a lesser extent in Coachella Valley, Calif. Fruit medium in tolerance to high humidity. Fruit small to medium; oblong-oval, base oblique, outline somewhat irregular; yellow, ripening to amber, curing to golden brown; midseason in ripening. Yields 125 to 150 pounds per palm.

Kustawy (kŭs-tä'wĭ).—A soft date from Iraq; grown in all date-producing districts, but no longer planted in Coachella Valley because of its small size and a rather pronounced tendency for the skin to separate from the flesh. Better fruit has been produced on heavier soils in other localities; it has a good record for withstanding occasional damp weather during ripening. Fruit small; oblong-ovate; yellow, ripening to amber, curing to brownish red; midseason in ripening. Yields 150 to 200 pounds per palm.

Maktoom (măk-to͞om').—A soft date from Iraq; occurs in a very few plantings in Coachella Valley, Calif., and on a somewhat larger scale in Salt River Valley, Ariz., where it seems to be best adapted to handling as a fresh date. Fruit medium in tolerance to high humidity. Fruit medium to large; broadly oblong; yellow, ripening to amber, curing to a deep chestnut brown; late ripening. Yields 175 to 225 pounds per palm.

Rhars (rärs).—A soft date from Algeria; one of the first varieties to be tested in the United States; scattered specimens still producing in southern California and Arizona, but no longer planted because the fruit is extremely susceptible to damage from rain or high humidity. Fruit large, narrowly oblong-obovate; yellow, ripening to amber, curing to reddish brown; very early ripening. Yields 200 to 250 pounds per palm.

Saidy (sī-ā'dĭ).—A soft date from Egypt; grown in a few large plantings in Coachella and Imperial Valleys, Calif. There are a few older palms of this variety in Salt River Valley, Ariz., where considerable losses of fruit during humid weather have not encouraged further planting. Fruit large; broadly oblong-oval with somewhat flattened base; orange-yellow, ripening to dull brown, curing to deeper shades; late ripening. Yields 175 to 250 pounds per palm.

Sayer (sī'yĕr).—A soft date from Iraq; planted to a very limited extent in Salt River Valley, Ariz. Fruit medium in tolerance to high humidity. Fruit medium to rather large; oblong to oblong-oval; yellow with faint longitudinal streaks of red near the base, ripening to amber, curing to deep reddish brown; midseason in ripening. Yields 175 to 200 pounds per palm.

Tazizoot (tăz-ĭ-zo͞ot').—A soft date from Algeria; represented in a few plantings in Coachella Valley, Calif., but no longer being planted because of lack of quality and heavy losses of fruit from occasional rains and high humidity. Fruit large; oblong-elliptical; yellow, ripening to amber, curing to dark brown; early ripening. Yields 200 to 250 pounds per palm.

Thoory (tho͞o'rĭ).—A dry date from Algeria; the only variety of this type planted, to a very limited extent, commercially in Coachella Valley, Calif. Fruit only slightly damaged by occasional high humidity. Fruit medium to large; oblong with rounded apex; yellow, ripening and curing to a clay or straw color with apical portions frequently dull brown; late ripening. Yields 200 to 250 pounds per palm.

Zahidi (zā'ĭ-dĭ).—A semidry date from Iraq; planted to some extent in all date-producing districts in California and Arizona. Growers of this variety claim its fruit can be handled more economically than that of most of the other varieties, although it is generally regarded as somewhat lacking in quality. Fruit a little less tolerant to rain or high humidity than Halawy and Khadrawy. Fruit small to medium; obovate; yellow, ripening to amber, curing to deep brown, except for dull-yellow or straw-colored areas of dry flesh retained at the base of many fruits; midseason in ripening. Yields 200 to 300 pounds per palm.

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